Patent Claims

1. Raster probe microscope for the examination of sample surfaces with:
- a raster probe (1),
- a holding device (23) for a sample (25) with the sample surface (30) to be examined;
- an arrangement (106) for moving the raster probe (1) and/or the sample (25) by which the raster probe (1) and/or the sample (25) are bringable into contact or are brought into contact so that they intereact with one another in a given manner; and with an arrangement for detecting the movement of the raster probe and/or sample; characterized by an arrangement (100, 102, 104) for controlling the movement of the raster probe and/or sample and for exciting a vertical first raster-probe and/or sample oscillation as well as a vertical and/or horizontal second raster-probe and/or sample oscillation; and
- an arrangement (103, 108) for detecting a vertical and/or a lateral deformation of the raster probe (1) in a vertical first or in a vertical and/or horizontal oscillation excitation and for the recording (Aufnehmen) of two measuring signals characterizing the deformation of the raster probe (1) in a vertical first or a vertical and/or horizontal second oscillation excitation of the raster probe (1) and/or of the sample (25).

2. Raster probe microscope according to claim 1, characterized in that the arrangement for moving the raster probe (1) and/or the sample (25) comprises at least one first piezo element.

3. Raster probe microscope according to claim 1 or 2, characterized by periodic raster-probe and/or sample

oscillations.

4. Raster probe microscope according to claim 3, characterized in that the oscillation direction runs parallel or perpendicular to the sensing (Abtast-) or scanning direction.

5. Raster probe microscope according to claim 3 or 4, characterized in that the vertical oscillation of the raster probe (1) and/or of the sample (25) occurs with a first frequency of at least 10 Hz and a first amplitude of at least 1 nm.

6. Raster probe microscope according to claim 4 or 5, characterized in that the frequency amounts to 500 Hz to 1 kHz and the amplitude to 10 to 500 nm.

7. Raster probe microscope according to claim 5 or 6, characterized in that the vertical oscillation of the raster probe (1) and/or of the sample (25) is additionally excited or modulated with a second frequency of at least 1 kHz and a second amplitude of at least 0.1nm.

8. Raster probe microscope according to claim 7, characterized in that the frequency ranges from 5 kHz to 1 MHz and the amplitude from 1 to 10 nm.

9. Raster probe microscope according to one of claims 3 to 8, characterized in that the sescond raster-probe and/or sample oscillation is a horizontal oscillation with a frequency of at least 500 Hz and an amplitude of at least 0.1 nm.

10. Raster probe microscope according to claim 7, characterized in that the frequency ranges from 10 to 100 kH and the amplitude from 1 to 30 nm.

11. Raster probe microscope according to one of the preceding claims, characterized in that an evaluating arrangement (17) for the two measuring signals for the simultaneous determination of at least two material properties, comprising the adhesion, the static and

dynamic friction, the surface topography as well as the elasticity and rigidity.

12. Raster probe microscope according to claim 11, characterized in that the evaluating arrangement comprises a lock-in amplifier (17) and/or a microcomputer (112).

13. Raster probe microscope according to one of the preceding claims, characterized in that the raster probe (1) is a point or tip (5) of a force microscope and/or of an optical near-field microscope.

14. Process for the simultaneous determination of at least two material properties, comprising the adhesion, the static and dynamic friction, the surface topography as well as the elasticity and rigidity of the surface of a sample (25) to be examined, by means of a raster probe microscope comprising a raster probe (1) with the following process steps:

14.1 Moving the raster probe (1) and/or the sample (25) with the sample surface (30) to be examined until the raster probe (1) at a pre-determined point (34) of the sample surface (30) to be examined, interacts in a determined manner with the sample surface (30), wherein the raster probe (1) and/or the sample (25) is subjected to a vertical first oscillation;

14.2 Recording of a first measuring signal characterizing the deformation of the raster probe (1);

14.3 Recording of a second measuring signal characterizing the deformation of the raster probe (1), in which the raster probe (1) and/or the sample (25) is subjected to a horizontal and/or vertical second oscillation;

14.4 Determination of the desired material properties from the two measuring signals; and

14.5 Scanning of the region of the sample surface (30) to be examined by a return to the process step 14.1.

15. Process according to claim 14, characterized in that the raster probe (1) and/or the sample (25) is subjected to at least one periodic oscillation.

16. Process according to claim 15, characterized in that the oscillation direction is chosen perpendicular to or parallel to the sensing or scanning direction.

17. Process according to one of claims 14 to 16, characterized in that the vertical oscillation or the vertical oscillations has/have a frequency of at least 10 Hz and an amplitude of at least 1 nm.

18. Process according to claim 17, characterized in that the frequency ranges from 500 Hz to 2 kHz and the amplitude from 10 to 500 nm.

19. Process according to claim 17 or 18, characterized in that on the vertical oscillation (or oscillations) there is superimposed at least one second oscillation with a frequency of at least 1 kHz and an amplitude of at 0.1 nm.

20. Process according to claim 19, characterized in that the frequency ranges from 5 kHz to 1 Mhz and the amplitude from 1 to 10 nm.

21. Process according to one of claims 14 to 20, characterized in that the horizontal oscillation has a frequency of at least 500 Hz and an amplitude of at least 0.1 nm.

22. Process according to claim 21, characterized in that the frequency ranges from 10 to 100 kHz and the amplitude from 1 to 30 nm.

23. Process according to one of claims 14 to 22, characterized in that the raster probe (1) is brought into contact with the sample surface (30) with a determined normal or perpendicular force.

24. Process according to one of claims 14 to 24, characterized in that for the evaluation of the measuring signals there is used a lock-in amplifier (17, 110) and/or a microcomputer (112).

25. Process according to one of claims 14 to 24, characterized in that as raster probe (1) there is used the point or tip (5) of a force microscope and/or of an optical near-field microscope.

26. Process according to claim 25, characterized in that the point or tip (5) of the force microscope and the point or tip of the optical near-field microscope are integrated in a common raster probe (1).

27. Process according to one of claims 14 to 26, characterized in that the raster probe (1) and/or the sample (15) are subjected simultaneously at least to a vertical and at least to a horizontal oscillation.